

US Wind Turbine Database Summary

Version: USWTDB V4.1

Release Date: July 21, 2021

I. ACRONYMS:

ACP	American Clean Power Association
DOF	Digital Obstacle File
FAA	Federal Aviation Administration
LBNL	Lawrence Berkeley National Laboratory
OE/AAA	Obstruction Evaluation / Airport Airspace Analysis
USGS	United States Geological Survey
EIA	Energy Information Administration
USWTDB	United States Wind Turbine Database

II. ABOUT THE DATABASE:

In 2016, USGS, LBNL, and ACP (formerly AWEA) began collaborating on development of the USWTDB. Their goal was to create a joint product that would be more comprehensive and accurate than their individual wind turbine data sets. Federal agencies began using these combined data in March 2017, and in April 2018 the data were released to the public. The database is maintained and updated quarterly to reflect new turbine additions, removals, and changes to the data.

These data are used by government agencies, scientists, private companies, and citizens for a variety of analyses. Examples include operational impact assessments of turbines on air defense radar, weather and general aviation, analyses related to the role of wind energy in the U.S. electric grid, interactions between wind energy facilities and wildlife, and investments in wind energy infrastructure.

The data were created by combining publicly-available data sets from the Federal Aviation Administration (FAA), USGS data from a prior effort, online sources, and data privately held by ACP and LBNL. The locations of all turbines are visually verified to within plus or minus 10 meters using high-resolution imagery. Technical specifications data of the turbines are collected from wind energy developers, equipment manufacturers, and from online sources.

III. DATA SOURCES:

Data were added, compiled, and updated in this edition of the USWTDB using the following sources:

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| • USGS Onshore Industrial Wind Turbine Locations for the United States | Release Date: March, 2014 |
| • LBNL Wind Turbine Database | Release Date: March, 2017 |
| • FAA Digital Obstacle File (DOF) | Release Date: May 18, 2021 |
| • FAA Obstruction Evaluation (OE/AAA) | Release Date: May 17, 2021 |
| • ACP Q4-2020 Wind Turbine Dataset | Release Date: May 17, 2021 |

- EIA Form 860 ER – Schedule 3 – Wind Data Release Date: June 3, 2021
- USGS Visual Verification (satellite imagery) Date: June, 2021

IV. VARIABLE CHANGES OR ADDITIONS:

No new variables were added this quarter.

V. VARIABLE NAMES AND DEFINITIONS:

Variable list and definitions can be found in the codebook that accompanies this release.

VI. SUMMARY OF DATASET AND CHANGES THIS QUARTER:

This edition of the USWTDB contains **69,166** turbines distributed across 44 U.S. States, Guam, and Puerto Rico.

Changes and updates to the database this quarter include the following:

- Addition of 951 turbine records. Additions include:
 - 951 new turbines.
- Removed 577 turbine records. Removals include:
 - 153 duplicate turbines removed.
 - 422 decommissioned turbines.
 - 2 reclassified as "not a turbine" (Either another structure mislabeled, or nothing in imagery >2 years after "built date").
- A total of 22,427 attribute changes were made. These include:

<ul style="list-style-type: none"> ▪ 8 "faa_ors" updates. ▪ 283 "faa_asn" updates. ▪ 31 "t_state" updates. ▪ 33 "t_county" updates. ▪ 33 "t_fips" updates. ▪ 1,963 "p_name" updates. ▪ 953 "p_year" updates. ▪ 2,288 "p_tnum" updates. ▪ 346 "t_manu" updates. ▪ 1,573 "t_model" updates. ▪ 2,021 "p_cap" updates. ▪ 1,241 "t_cap" updates. 	<ul style="list-style-type: none"> ▪ 140 "t_hh" updates. ▪ 1,566 "t_rd" updates. ▪ 1,566 "t_rsa" updates. ▪ 1,575 "t_ttlh" updates. ▪ 1,571 "retrofit" updates. ▪ 573 "t_conf_atr" updates. ▪ 825 "t_conf_loc" updates. ▪ 1,297 "t_img_date" updates. ▪ 2,398 "t_img_srce" updates. ▪ 86 "xlong" updates. ▪ 66 "ylat" updates.
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VII. NUMBER OF WIND TURBINES BY STATE:

The USWTDB currently includes wind turbines from 44 U.S. states, plus Guam and Puerto Rico. Table 2 reports the number of turbines in each of these states and territories for the current release (Q2-2021) as well as the previous quarterly release (Q1-2021) for comparison. The changes by state reported in Table 2 may be due to turbines added to the dataset (via FAA and ACP data) and/or duplicate and decommissioned turbines removed from the dataset.

Table 2: Summary of Turbines by State

State	Q1-2021	Q2-2021	Change	State	Q1-2021	Q2-2021	Change
AK	142	141	-1	ND	2,193	2,194	1
AR	1	1	0	NE	1,386	1,387	1
AZ	270	269	-1	NH	84	84	0
CA	6,819	6,541	-278	NJ	6	6	0
CO	2,764	2,764	0	NM	1,555	1,677	122
CT	3	3	0	NV	68	68	0
DE	1	1	0	NY	1,170	1,197	27
FL	2	1	-1	OH	503	503	0
GU	1	1	0	OK	4,552	4,642	90
HI	132	132	0	OR	2,064	2,064	0
IA	5,951	5,998	47	PA	751	751	0
ID	541	541	0	PR	63	63	0
IL	3,275	3,308	33	RI	32	32	0
IN	1,541	1,541	0	SD	1,340	1,343	3
KS	3,679	3,723	44	TN	18	18	0
MA	92	92	0	TX	16,546	16,963	417
MD	80	80	0	UT	208	208	0
ME	408	408	0	VA	2	2	0
MI	1,556	1,534	-22	VT	73	73	0
MN	2,824	2,688	-136	WA	1,825	1,825	0
MO	1,123	1,161	38	WI	451	451	0
MT	669	669	0	WV	396	396	0
NC	105	105	0	WY	1,527	1,517	-10
				TOTAL	68,792	69,166	374

VIII. CONFIDENCE IN TURBINE LOCATIONS:

The level of confidence¹ in turbine latitude/longitude coordinates remains very high, thanks to the visual verification efforts from USGS. Currently, 64,641 (93.5%) turbine points have high location confidence, and only 6.0 % of turbines have low location confidence. 100% of the turbine locations in this dataset have been visually examined using satellite imagery. Location confidence of points is summarized in Table 3.

Table 3: Level of confidence in turbine locations

Location Confidence	Q1-2021		Q2-2021	
	Freq.	Percent	Freq.	Percent
(3) High	64,006	93.0%	64,641	93.5%
(2) Partial	409	0.6%	345	0.5%
(1) Low/none	4,377	6.4%	4,180	6.0%
(0) Not checked	0	0.0%	0	0.0%

We are aware of the existence of turbines in the dataset that have a *high* location confidence but have been dismantled. These would be turbines that were previously verified but have since been decommissioned. If users are aware of any turbines that have been dismantled but remain in the dataset please send an email to uswtodb@lbl.gov with details about them, or use the “submit a suggested correction” button via the USWTDB online viewer. Note that the *case_id* for the turbine being corrected will automatically be included if you use the button via the viewer. If you submit a correction via email, please include *case_id*.

¹ **Location confidence** (conf_loc) is rated on a 0-3 scale:

- 0—Not visually verified (these points are in the queue for verification in the next quarter)
- 1—No turbine shown in image; image has clouds; imagery older than turbine built date
- 2—Partial confidence: image shows a developed pad with concrete base and/or turbine parts on the ground
- 3—Full confidence: image shows an installed turbine or a tower being constructed; at least partially installed

IX. CONFIDENCE IN TURBINE ATTRIBUTES:

The level of confidence² in the attributes (such as total height, hub height, and rotor diameter) of each wind turbine remains high. We have high confidence in attributes for 85.5% of the turbines, partial confidence in 6.3% of turbines, and low or no confidence in 8.3%. Turbine points are categorized as “partial” confidence if the ACP attribute data conflicts substantially³ with existing records. Attribute confidence is summarized in Table 4.

Table 4: Level of confidence in turbine attributes

Attribute Confidence	Q1-2021		Q2-2021	
	Freq.	Percent	Freq.	Percent
(3) High	59,314	86.2%	59,104	85.5%
(2) Partial	4,436	6.5%	4,330	6.3%
(1) Low/none	5,042	7.3%	5,732	8.3%
(0) Not checked	0	0.0%	0	0.0%

The seven attributes that are collected are well populated across the dataset. Each attribute is populated in at least 92% of turbines, and over 92% of turbines in the USWTDB have data populated in *all seven* turbine attributes. Attribute data are summarized in Table 5.

Table 5: Number of turbines with data populated and summary statistics for seven turbine attributes

Turbine Attribute	# of Turbines	% of Turbines	Minimum	Median	Maximum
Project year	68,649	99.25%	1981	2012	2021
Total height (m)	63,969	92.49%	30.4	130.1	199.6
Hub height (m)	63,969	92.49%	19	80	131
Rotor diameter (m)	64,213	92.84%	13.4	96	155
Capacity (kW)	64,670	93.50%	50	2000	6000
Turbine Manufacturer	64,574	93.36%	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
Turbine Model	64,351	93.04%	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
<i>All Seven Attributes</i>	<i>63,819</i>	<i>92.27%</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>

² **Attribute confidence** (conf_attr) is rated on a 1-3 scale:

1—No confidence: no facility data, no name, nothing in publications

2—Partial confidence: incomplete information or substantial conflict between data sources

3—Full confidence: consistent information across multiple data sources

³ A “substantial” conflict was defined as any of the following differences (+/-): p_year 4 years; t_hh 10 meters; t_rd 10 meters; t_ttlh 50 feet; t_cap 250 kW. These tolerances will also be examined in the coming quarters and are expected to tighten over time.